CLAIMS

What is claimed is:

1. A method of controlling power of a laser diode emitting laser light on a disc by using a difference between a level of the laser light reflected by the disc and a reference level, the difference being detected after the laser light level reflected by the disc is compared with the reference level, the method comprising:

(a) generating a periodic synchronization signal; and

(b) controlling the power of the laser diode in synchronism with the synchronization signal.

2. The method of claim 1, wherein the step (b) comprises:

(b1) comparing a level of the power of the laser diode with the reference level;

(b2) latching the compared result in response to the synchronization signal; and

(b3) controlling the power level of the laser diode according to the difference between the latched power level and the reference level.

3. The method of claim 2, wherein in the sub-step (b1), the synchronization signal has a predetermined enable interval, and the power level of the laser diode is latched during the enable interval.

4. The method of claim 3, wherein the sub-step (b1) further comprises sampling the power level of the laser diode during the enable interval, and latching an average of the sampled power levels.

5. The method of claim 1, wherein the disc is a digital versatile disc-read only memory (DVD-ROM), and the synchronization signal is a mirror signal indicating a mirror area of the DVD-ROM.

6. The method of claim 1, wherein the disc is a digital versatile disc-read only memory (DVD-ROM), and the synchronization signal is a gap signal indicating a gap area of the DVD-ROM.

7. The method of claim 1, wherein the disc is a digital versatile disc-random access memory (DVD-RAM), and the synchronization signal is obtained by dividing a clock signal required to drive the DVD-RAM by a ratio.

8. The method of claim 7, further comprising varying the division ratio.

9. The method of claim 1, wherein the step (b) comprises:

(b1) sampling control values designating a level of the power of the laser diode, in synchronism with the synchronization signal;

(b2) calculating an average of a predetermined number of the sampled control values; and

(b3) controlling the power level of the laser diode in accordance with the average of the sampled control values.

10. The method of claim 9, wherein the synchronization signal is obtained by dividing a clock signal required to drive the disc by a ratio.

11. The method of claim 10, further comprising varying the division ratio.

12. An apparatus for controlling a power of a laser diode emitting laser light on a disc, comprising:

a photo diode which receives the laser light reflected by the disc to generate a current signal corresponding to a level of power of the reflected laser light;

a comparator which outputs an output voltage corresponding to the current signal from the photo diode compares the output voltage with a reference voltage and outputs a binary decision signal which indicates which of the output voltage and the reference voltage is higher;

an up/down counter which up/down counts the binary decision signal in accordance with the comparison result of the comparator to generate a count result;

a laser diode driver which controls a level of the power of the laser diode according to the count result of the up/down counter; and

an automatic power (APC) controller which controls an automatic power control of the laser diode, the ACP controller being interposed between the up/down counter and the laser diode driver, the APC controller latching the count result of the up/down counter in synchronism with a periodic synchronization signal, and outputting the latch result to the laser diode driver.

13. The apparatus of claim 12, wherein the synchronization signal has a predetermined enable interval, and the APC controller latches the counted result from the up/down counter at an end of the enable interval.

14. The apparatus of claim 13, wherein the APC controller samples the counted result from the up/down counter during the enable interval, and latches an average of a predetermined number of the sampled counted results.

15. The apparatus of claim 12, wherein the disc is a digital versatile disc-read only memory (DVD-ROM), and the synchronization signal is a mirror signal indicating a mirror area of the DVD-ROM.

16. The apparatus of claim 12, wherein the disc is a digital versatile disc-read only memory (DVD-ROM), and the synchronization signal is a gap signal indicating a gap area of the DVD-ROM.

17. The apparatus of claim 12, wherein the disc is a digital versatile disc-random access memory (DVD-RAM), the apparatus further comprising a divider which divides a clock signal required to drive the DVD-RAM by a ratio to generate the synchronization signal.

18. The apparatus of claim 17, wherein the divider varies the division ratio.

19. The apparatus of claim 12, wherein the APC controller samples sampling control values designating the power level of the laser diode, in synchronism with the synchronization signal, and latches a predetermined number of the sampled sampling control values.

20. The apparatus of claim 19, wherein the disc is a digital versatile disc-random access memory (DVD-RAM), the apparatus further comprising a divider which divides a clock signal required to drive the DVD-RAM by a ratio to generate the synchronization signal.

21. The apparatus of claim 20, wherein the divider varies the division ratio.

22. The method of claim 1, wherein the step (b) comprises controlling the power of the laser diode only at non-effective data areas of the disc.

23. The method of claim 1, wherein the step (b) comprises generating the synchronization signal selectively in accordance with a sub automatic power control (APC) mode, an average APC mode and a sub-average APC mode for the disc.

24. The method of claim 1, further comprising:

adjusting the reference level based upon a read mode, a record mode and an erase mode for the disc.

25. The method of claim 24, wherein the adjusting of the reference level comprises:

adjusting the reference level to a first value if the mode for the disc is the read mode;

adjusting the reference level to a second value if the mode for the disc is the erase mode for lands of the disc;

adjusting the reference level to a third value if the mode for the disc is the erase mode for grooves of the disc;

adjusting the reference level to a fourth value if the mode for the disc is the record mode for the lands of the disc; and

adjusting the reference level to a fifth value if the mode for the disc is the record mode for the grooves of the disc.

26. The method of claim 1, wherein the step (b) comprises:

comparing a level of the power of the laser diode to the reference level;

up/downcounting according to the compared result to determine a counted result;

latching the counted result in accordance with the synchronization signal, to determine a latched power signal; and

controlling the power of the laser diode in accordance with the latched power signal.

27. The method of claim 26, wherein the synchronization signal is a mirror or gap signal or a clock signal required to drive the disc divided by a ratio into a division signal.

28. The method of claim 26, wherein:

the up/downcounting comprises

up/downcounting the counted result to generate a first count in a read mode for the disc,

up/downcounting the counted result to generate a second count in an erase mode of lands of the disc,

up/downcounting the counted result to generate a third count in the erase read mode for grooves of the disc,

up/downcounting the counted result to generate a fourth count in a record mode of the lands of the disc, and

up/downcounting the counted result to generate a fifth count in the record mode for the grooves of the disc; and

selectively using the first through fifth counts as the counted value for the latching of the counted result.

29. The method of claim 28, further comprising:

multiplexing the second and third counts to generate a first multiplexed signal;

multiplexing the fourth and fifth counts to generate a second multiplexed signal; and

the latching of the counted result comprising selectively latching the first count, the first multiplexed signal and the second multiplexed signal based upon a respective one of the read, erase and record modes of the disc.

30. The method of claim 29, wherein the latching of the counted result comprises latching the counted result in a period of a mirror or gap signal or a clock signal divided by a ratio into a division signal.

31. The method of claim 26, wherein the latching of the counted result comprises:

sampling the counted result;

averaging a predetermined number of the sampled counted results to determine an average value; and

latching the average value in accordance with the synchronization signal, to determine the latched power signal.

32. The method of claim 31, wherein the synchronization signal is a mirror or gap signal or a clock signal divided by a ratio into a division signal.

33. The method of claim 26, wherein the latching of the counted result comprises:

sampling the counted result;

averaging the sampled counted results during enablement of the synchronization signal to determine an average value; and

latching the average value in accordance with the synchronization signal, to determine the latched power signal.

34. The method of claim 33, wherein the synchronization signal is a mirror or gap signal or a clock signal divided by a ratio into a division signal.

35. A method of controlling power of a laser diode which emits a laser light on a disc, the method comprising:

detecting a level of the power of the laser diode reflected from the disc;

controlling the power of the laser diode only at non-effective data areas of the disc in accordance with the detected power level of the laser diode.

36. The method of claim 35, wherein the controlling of the power of the laser diode comprises:

comparing the detected power level with a reference signal;

generating a power level signal in accordance with the compared result;

generating a synchronization signal;

latching the power level signal in accordance with the synchronization signal to determine a latched power level signal; and

supplying the latched power level signal to the laser diode to control the power of the laser diode.

37. The method of claim 36, wherein the synchronization signal is a mirror signal, a gap signal or a clock signal to drive the disc divided by a ratio into a division signal.

38. An apparatus for controlling a power of a laser diode emitting light on a disc, the apparatus comprising:

a laser driver which controls the power of the laser diode in accordance with a control signal; and

a control circuit which generates the control signal in synchronism with a periodic synchronization signal.

39. The apparatus of claim 38, wherein the control circuit comprises:

a detector which detects the light reflected from the disc, to generate a detected power level of the laser diode;

power signal circuit which generates a power signal in accordance with the detected power level; and

an automatic power controller which latches the power signal in synchronism with the synchronization signal, to generate the control signal.

40. The apparatus of claim 39, wherein the power signal circuit comprises:

a comparator which compares the detected power level of the laser diode with a reference level; and

an up/down counter which up/downcounts according to the output of the comparator to determine a counted result, wherein the counted result is input as the power signal to the automatic power controller.

41. The apparatus of claim 40, wherein the synchronization signal is a mirror signal, a gap signal or a clock signal required to drive the disc divided by a ratio into a division signal.

42. The apparatus of claim 40, wherein the power signal circuit further comprises:

a reference value generator which adjusts the reference level based upon a read mode, a record mode and an erase mode for the disc.

43. The apparatus of claim 42, wherein:

the reference value generator comprises:

a first latch which adjusts the reference level to a first value if the mode for the disc is the read mode

a second latch which adjusts the reference level to a second value if the mode for the disc is the erase mode for lands of the disc,

a third latch which adjusts the reference level to a third value if the mode for the disc is the erase mode for grooves of the disc,

a fourth latch which adjusts the reference level to a fourth value if the mode for the disc is the record mode for the lands of the disc,

a fifth latch which adjusts the reference level to a fifth value if the mode for the disc is the record mode for the grooves of the disc; and

a multiplexer which selectively outputs the second through fifth values according to whether a current mode is the erase or record mode and whether a current track is the land or groove; and

the comparator comprises:

a first comparator which compares the first latched value and the detected power level in the read mode, and

a second comparator which compares the second latched value and the detected power level in the erase or record mode.

44. The apparatus of claim 43, further comprising:

a microcomputer which supplies a first initial reference value to the first latch for adjusting the reference value, a second initial reference value to the second latch for adjusting the reference value, a third initial reference value to the third latch for adjusting the reference

value, a fourth initial reference value to the fourth latch for adjusting the reference value, and a fifth initial reference value to the fifth latch for adjusting the reference value.

45. The apparatus of claim 40, wherein:

the up/down counter comprises:

a first up/downcounter which up/downcounts the counted result to generate a first count in a read mode for the disc,

a second up/downcounter which up/downcounts the counted result to generate a second count in an erase mode of lands of the disc,

a third up/downcounter which up/downcounts the counted result to generate a third count in the erase read mode for grooves of the disc,

a fourth up/downcounter which up/downcounts the counted result to generate a fourth count in a record mode of the lands of the disc, and

a fifth up/downcounter which up/downcounts the counted result to generate a fifth count in the record mode for the grooves of the disc; and

the automatic power controller selectively uses the first through fifth counts as the counted value for the latching of the counted result.

46. The apparatus of claim 45, wherein the power signal circuit further comprises:

a first multiplexer which multiplexes the second and third counts to generate a first multiplexed signal; and

a second multiplexer which multiplexes the fourth and fifth counts to generate a second multiplexed signal;

wherein the automatic power controller selectively latches the first count, the first multiplexed signal and the second multiplexed signal based upon a respective one of the read, erase and record modes of the disc.

47. The apparatus of claim 46, wherein the synchronization signal is a mirror signal, a gap signal or a clock signal to drive the disc divided by a ratio into a division signal.

48. The apparatus of claim 40, wherein the automatic power controller latches the counted result in a period of a mirror or gap signal or a clock signal divided by a ratio into a division signal.

49. The apparatus of claim 40, wherein the automatic power controller samples the counted result, averages a predetermined number of the sampled counted results to determine an average value, and latches the average value in accordance with the synchronization signal, to determine the control signal.

50. The apparatus of claim 49, wherein the synchronization signal is a mirror or gap signal or a clock signal divided by a ratio into a division signal.

51. The apparatus of claim 40, wherein the automatic power controller samples the counted result, averages the sampled counted results during enablement of the synchronization signal to determine an average value, and latches the average value in accordance with the synchronization signal, to determine the control signal.

52. The method of claim 51, wherein the synchronization signal is a mirror or gap signal or a clock signal divided by a ratio into a division signal.

53. An apparatus for controlling power of a laser diode which emits a laser light on a disc, the apparatus comprising:

a detector which detects a level of the power of the laser diode reflected from the disc;

a control circuit which controls the power of the laser diode only at non-effective data areas of the disc in accordance with the detected power level of the laser diode.

54. The method of claim 53, wherein the control circuit comprises:

a comparator which compares the detected power level with a reference signal;

a power level generator which generates a power level signal in accordance with the

output of the comparator;

an automatic power controller which latches the power level signal in accordance with a synchronization signal to determine a latched power level signal; and

a laser diode driver which supplies the latched power level signal to the laser diode to control the power of the laser diode.

55. The method of claim 54, wherein the synchronization signal is a mirror signal, a gap signal or a clock signal to drive the disc divided by a ratio into a division signal.

56. The apparatus of claim 43, wherein:

the up/down counter comprises:

a first up/downcounter which up/downcounts according to the output from the first comparator to generate a first count in a read mode for the disc,

a second up/downcounter which up/downcounts according to the output from the second comparator to generate a second count in an erase mode of lands of the disc,

a third up/downcounter which up/downcounts according to the output from the second comparator to generate a third count in the erase read mode for grooves of the disc,

a fourth up/downcounter which up/downcounts according to the output from the second comparator to generate a fourth count in a record mode of the lands of the disc, and

a fifth up/downcounter which up/downcounts according to the output from the second comparator to generate a fifth count in the record mode for the grooves of the disc; and

the automatic power controller selectively uses the first through fifth counts as the counted value for the latching of the counted result.

57. An apparatus for controlling power of a laser diode which emits a laser light on a disc, the apparatus comprising:

a detector which detects a level of the power of the laser diode reflected from the disc;

a control circuit which controls the power of the laser diode based upon a sub automatic power controller mode, an average automatic power controller mode, and a sub-average automatic power controller mode and in accordance with the detected power level of the laser diode.

output of the comparator;

an automatic power controller which latches the power level signal in accordance with a synchronization signal to determine a latched power level signal; and

a laser diode driver which supplies the latched power level signal to the laser diode to control the power of the laser diode.

55. The method of claim 54, wherein the synchronization signal is a mirror signal, a gap signal or a clock signal to drive the disc divided by a ratio into a division signal.

56. The apparatus of claim 43, wherein:

the up/down counter comprises:

a first up/downcounter which up/downcounts according to the output from the first comparator to generate a first count in a read mode for the disc,

a second up/downcounter which up/downcounts according to the output from the second comparator to generate a second count in an erase mode of lands of the disc,

a third up/downcounter which up/downcounts according to the output from the second comparator to generate a third count in the erase read mode for grooves of the disc,

a fourth up/downcounter which up/downcounts according to the output from the second comparator to generate a fourth count in a record mode of the lands of the disc, and

a fifth up/downcounter which up/downcounts according to the output from the second comparator to generate a fifth count in the record mode for the grooves of the disc; and

the automatic power controller selectively uses the first through fifth counts as the counted value for the latching of the counted result.

57. An apparatus for controlling power of a laser diode which emits a laser light on a disc, the apparatus comprising:

a detector which detects a level of the power of the laser diode reflected from the disc;

a control circuit which controls the power of the laser diode based upon a sub automatic power controller mode, an average automatic power controller mode, and a sub-average automatic power controller mode and in accordance with the detected power level of the laser